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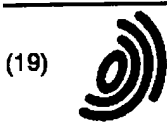
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(72) Inventor: **McCann, James Douglas**  
**Wigan WN1 2SX, Greater Manchester (GB)**

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(74) Representative: **Lee, Michael John et al**  
**Group Patents Department,**  
**Pilkington PLC,**  
**Pilkington Technology Centre,**  
**Hall Lane,**  
**Lathom**  
**Ormskirk, Lancashire L40 5UF (GB)**

(71) Applicant: **PILKINGTON UNITED KINGDOM**  
**LIMITED**  
**St. Helens, Merseyside WA10 3TT (GB)**

### (54) **Suspended sheet assemblies**

(57) A suspended sheet assembly (1) has a sheet (2), for example toughened glass, a supporting element (4) fastened to the sheet (2) and a suspension device (6) for attaching the supporting element (4) to a structure such as the framework of beams in a building. The supporting element (4) has an elongate supporting member (8) and clamping means (26,28,30,32) and extends through an aperture (14) in the sheet (2). The suspen-

sion device (6) has a substantially planar attachment portion (22). The elongate supporting member (8) is clamped to the attachment portion (22) with its longitudinal axis X at any of a range of angles to the plane R of the attachment portion (22), and thereby the sheet (2) can be suspended inclined to the horizontal/vertical and to adjacent sheets clamped to the same suspension device (6).

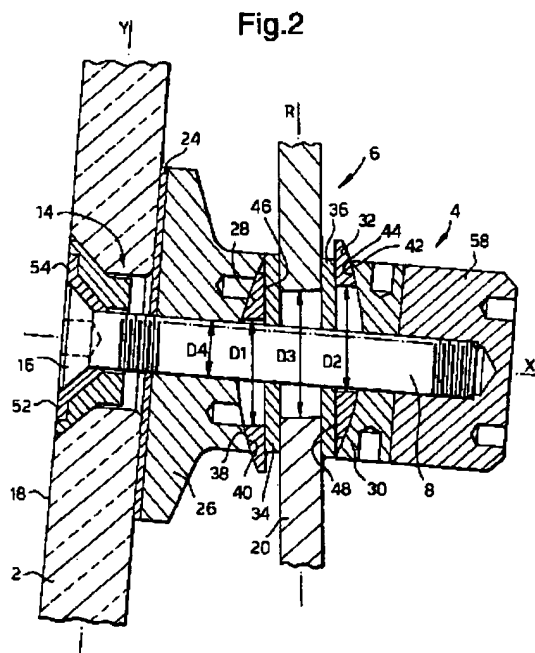


Fig.2

EP 0 784 129 A1

## Description

The invention relates to suspended sheet assemblies which generally comprise a sheet, at least one supporting element and one or more suspension devices by which each supporting element is attached to a structure. Such suspended assemblies with sheets of glass are used to glaze the exterior walls or roofs of buildings.

Pilkington United Kingdom Limited have for some time in the UK and elsewhere offered their PLANAR glazing range which includes a number of different suspended glazing assemblies. One particular arrangement involves having adjacent single glazed panes of glass provided at, for example, each of their four corners with supporting elements each consisting primarily of a bolt which extends through an aperture in the respective pane and is fastened thereto. The bolt is clamped to a suspension device, one type being known as a spring plate, to which one or more bolts from adjacent panes are also clamped. The spring plate is intended to be attached to a structure such as a stanchion or beam in a building. The suspended glazing assembly may be suspended solely from the stanchions or beams or may also be supported by the ground.

Most commonly, suspended glazing assemblies are supported either entirely horizontally or entirely vertically or with all panes at the same or a similar angle of inclination, but there is increasingly a demand to have glazing assemblies wherein adjacent panes are inclined with respect to one another so as to provide, for instance, effectively curved walls.

The invention provides a suspended sheet assembly comprising a sheet, a supporting element fastened to the sheet and a suspension device for attaching the supporting element to a structure, the supporting element having an elongate supporting member and clamping means and extending through an aperture in the sheet, the suspension device having a substantially planar attachment portion, characterised in that the longitudinal axis of the supporting member is substantially perpendicular to the plane of the sheet and the supporting member is clamped to the attachment portion by the clamping means with said longitudinal axis at any of a range of angles to the plane of the attachment portion.

The ability to select an angle at which the supporting member is clamped enables the sheet to be suspended inclined at various angles to the horizontal or vertical and at a different angle of inclination to an adjacent sheet clamped to the same suspension device.

Preferably, the supporting member comprises a bolt which extends through the attachment portion, and the clamping means comprises a first nut and clamping ring set threaded on to the bolt on one side of the attachment portion and a second nut and clamping ring set threaded on to the bolt on the other side of the attachment portion, and the attachment portion is clamped between the two nut and clamping ring sets.

Further preferably, the nut and clamping ring in each

set are in abutment, the abutting surfaces of each nut and clamping ring are similarly curved and each clamping ring has an opposite surface which is flat.

The internal diameter of each clamping ring may be larger than the external diameter of the bolt, and the aperture in the attachment portion through which the bolt extends may be wider than the external diameter of the bolt.

The suspension device may comprise an arm, with the attachment portion at one end of the arm and the other end of the arm connected to an attachment centre for attachment to the structure, and the plane of the attachment portion substantially parallel to but spaced apart from the plane of the attachment portion.

The sheet may be a pane of glass which could be toughened or laminated and clear, coated or body coloured. In one specific construction of laminated pane, the bolt head is intended to be between the two plies of the laminate. The sheet could be one of the panes of a multiple glazed unit.

An embodiment of the invention will now be described, by way of example, by reference to the following drawings in which:

Figure 1 is an elevation of part of the outside of a "curved" suspended glazed wall according to the invention;

Figure 2 is a partial cross-sectional view of the wall shown in figure 1 taken along the line II-II;

Figures 3 and 4 are a rear view and cross-sectional view (taken along the line IV-IV) respectively of one type of suspension devices (spring plates) suitable for use in assemblies according to the invention; and

Figure 5 is a partial side view of the wall shown in figure 1.

Figure 1 shows an assembly of inclined glass panes 2 suspended in edge-to-edge fashion from a framework of structural beams (not shown) behind the panes 2 to form a glass wall indicated generally at 1 which is curved in the sense that each successively higher pane 2 is inclined at a greater angle to the horizontal (measured anti-clockwise) than the pane 2 below.

With reference also to figure 2, the panes 2 of 10 mm thick, toughened, body coloured glass have fastened to them a supporting element 4 which is attached to a suspension device 6 (only partially illustrated in figure 2). The supporting element 4 has a metal bolt 8, which constitutes a supporting member, and clamping means in the form of two nut and clamping ring sets 26,28,30,32. The bolt 8 extends through an aperture 14 in the pane 2 with its longitudinal axis X substantially perpendicular to the plane Y of the pane 2. The aperture 14 is counter-sunk so that the head 16 of the bolt 8 is flush with the outer surface 18 of the pane 2 and the head 16 sits in the uppermost of a pair of interengaging washers 52,54.

Referring also to figures 3 and 4, the suspension device 6, otherwise known as a spring plate, has four arms 20a-d (only one of which is shown in figure 1) and at the end of each arm 20 there is a substantially planar attachment portion 22 lying in a plane R. The four arms 20a-d, are each connected at their other ends to an attachment centre 56 which is used to attach the suspension device 6 to a structural beam (not shown). The plane R of the attachment portions 22a-d and the plane S of the attachment centre 56 are substantially parallel but spaced apart as the arms 20a-d are cranked.

Each of the attachment portions 22a-d, which are generally circular, has an aperture 24a-d at its centre and the bolt 8 passes through the aperture 14. The nut and clamping ring sets 26, 28, 30, 32 are threaded on to the bolt 8. The first set 26,28 is to the pane 2 side of the suspension member 6 and separated from the pane 2 by a silicone rubber or plastics material washer 24. The second set 30,32 is on the opposite side of the suspension member 6. Each set 26,28,30,32 is separated from the suspension member 6 by a silicone rubber or plastics material washer 34,36. The first nut 26 is tightened against the pane 2 thereby making the bolt 8 fast with the pane 2. The second nut 30 is tightened so as to clamp the attachment portion 22 between clamping rings 28,32. A third capping nut 58 is threaded on to the end of the bolt 8 remote from the pane 2.

Each nut 26,30 and clamping ring 28,32 in each set is in abutment, and the abutting surfaces 38,40 and 42,44 of each set 26,28,30,32 are similarly curved. Each clamping ring 28,32 has a flat clamping surface 46,48 opposite the curved surface 40,44 and nearest the attachment portion 22. The internal diameter D1,D2 of each clamping ring 28,32 and the internal diameter D3 of the aperture 24 are much greater than the external diameter D4 of the bolt 8. Thus, in the unclamped state, the clamping rings 28,32 are able to swivel with respect to the nut 26,30 against which they abut, thereby enabling the bolt 8 to be pivoted with respect to the suspension device 6. When the nuts 26,30 are tightened, a component of the force they exert is applied by the clamping ring 28,32 substantially perpendicularly to the plane R of the attachment portion 22, irrespective of the angle of the bolt 8. Hence, the bolt 8 can be clamped to the suspension device 6 with its longitudinal axis X, at any of a range of angles to the plane R of the attachment portion 22, and the angle can be different to the angle of inclination of the adjacent pane 2.

As partially illustrated in Figure 5, adjacent panes 2, one above the other, are inclined with respect to the horizontal and with respect to one another. The panes 2 are each attached to the same suspension device 6 by supporting elements 4. The suspension device 6 is bolted through its attachment centre 56 to a structural beam 58 which is part of a building framework.

## Claims

1. A suspended sheet assembly comprising a sheet (2), a supporting element (4) fastened to the sheet (2) and a suspension device (6) for attaching the supporting element (4) to a structure, the supporting element (4) having an elongate supporting member and clamping means and extending through an aperture (14) in the sheet (2), the suspension device (6) having a substantially planar attachment portion (22), characterised in that the longitudinal axis (X) of the supporting member is substantially perpendicular to the plane (Y) of the sheet (2) and the supporting member is clamped to the attachment portion (22) by the clamping means with said longitudinal axis (X) at any of a range of angles to the plane (R) of the attachment portion.
2. An assembly according to claim 1 wherein the supporting element (4) comprises a bolt (8) which extends through the attachment portion (22), and the clamping means comprises a first nut and clamping ring set (26,28) threaded on to the bolt (8) on one side of the attachment portion (22) and a second nut and clamping ring set (30,32) threaded on to the bolt (8) on the other side of the attachment portion (22), and the attachment portion (22) is clamped between the two nut and clamping ring sets (26,28; 30,32).
3. An assembly according to claim 2 wherein the nut and clamping ring in each set (26,28;30,32) are in abutment, the abutting surfaces (38,40;42,44) of each nut and clamping ring are similarly curved and each clamping ring (40;44) has an opposite clamping surface which is flat (46;48).
4. An assembly according to claim 3 wherein the internal diameter (D1;D2) of each clamping ring (28; 32) is greater than the external diameter (D3) of the bolt (8).
5. An assembly according to any of claims 2 to 4 wherein the aperture (24) in the attachment portion (22) through which the bolt (8) extends is wider than the external diameter (D3) of the bolt (8).
6. An assembly according to any of claims 1 to 5 wherein the suspension device (6) comprises an arm (20), the attachment portion (22) is at one end of the arm (20), the other end of the arm is connected to an attachment centre (56) for attachment to the structure, and the plane (R) of the attachment portion (22) is substantially parallel to but spaced apart from the plane(s) of the attachment centre (56).
7. An assembly according to any of claims 2 to 6

wherein each nut and clamping ring set (26,28; 30,32) is separated from the attachment portion (22) by a spacer washer (34;36).

8. An assembly according to any of claims 2 to 7 5  
wherein the clamping means further comprises a  
capping nut (58) threaded onto the end of the bolt  
(8) remote from the sheet (2).
9. An assembly according to any of claims 2 to 8 10  
wherein the nut (26) nearest the sheet (2) serves  
also to fasten the bolt (8) to the sheet (2).
10. An assembly according to any preceding claim 15  
wherein the sheet (2) is glass.

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Fig.1.

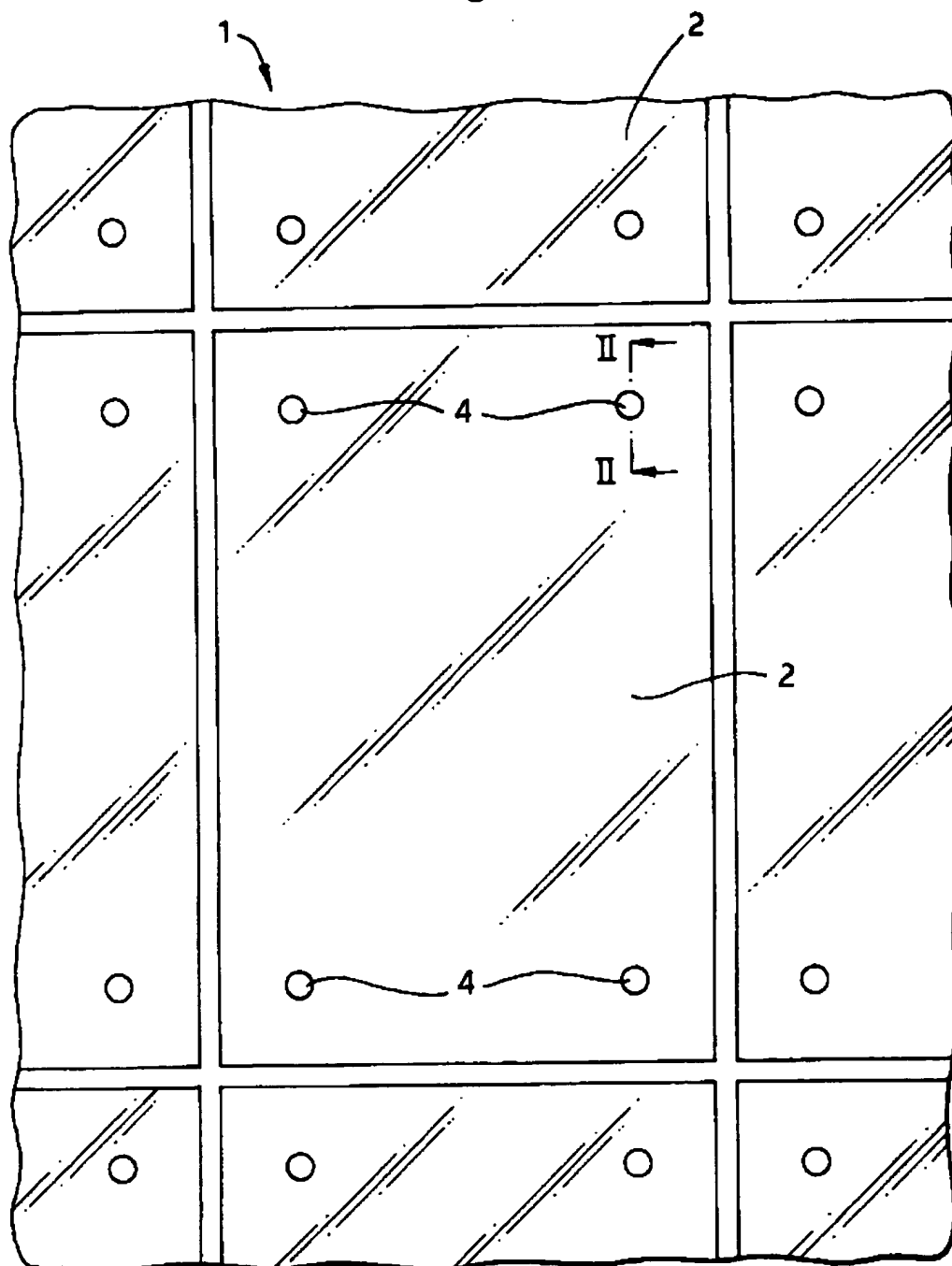
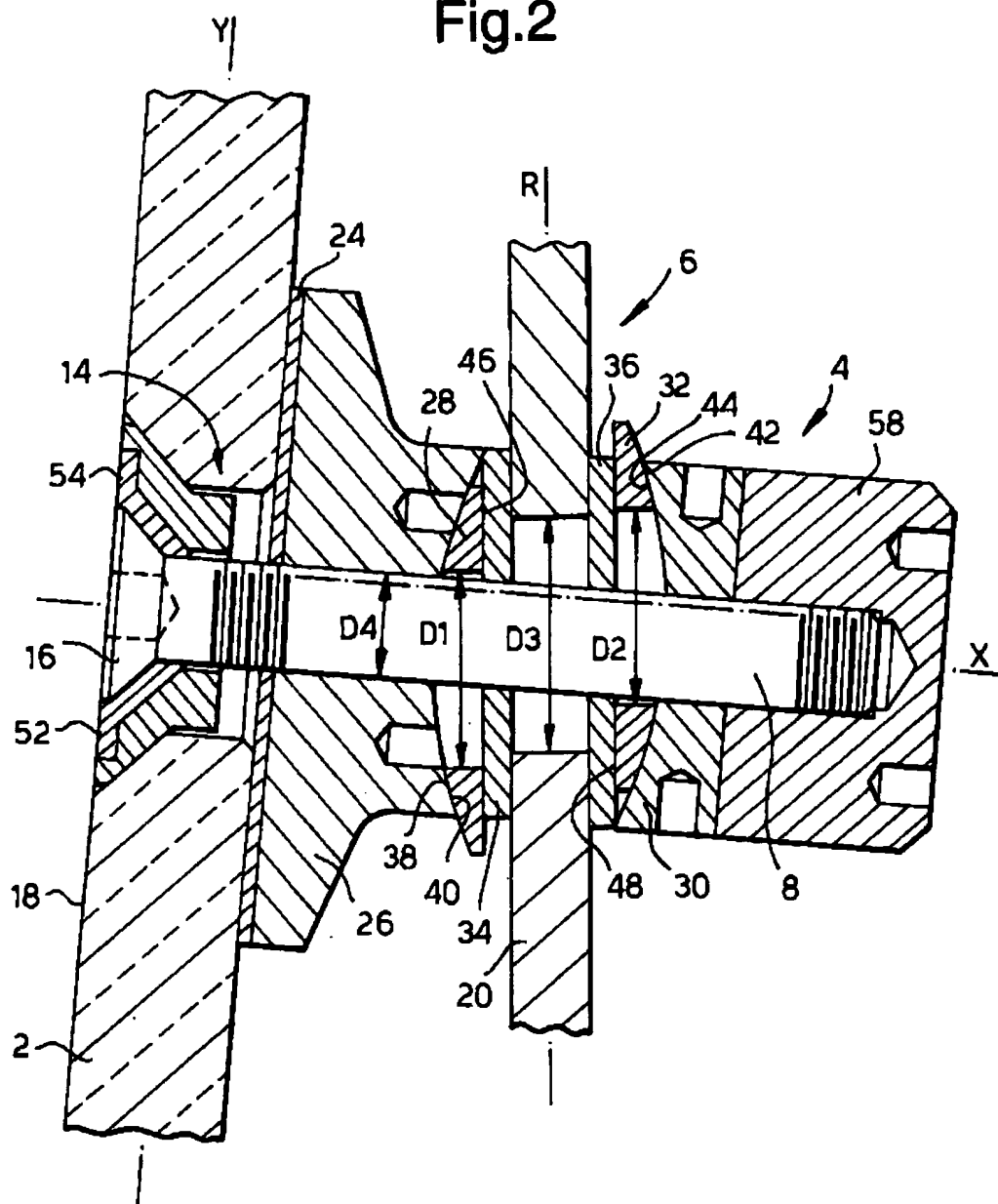


Fig.2



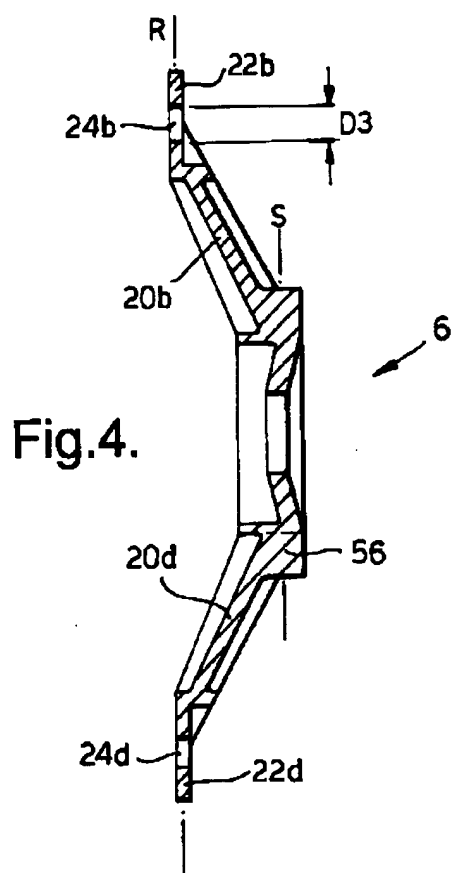
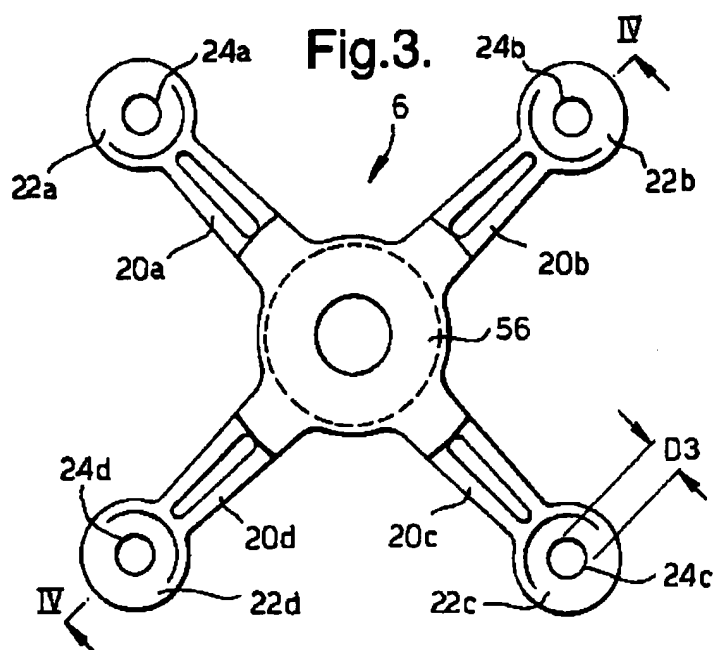
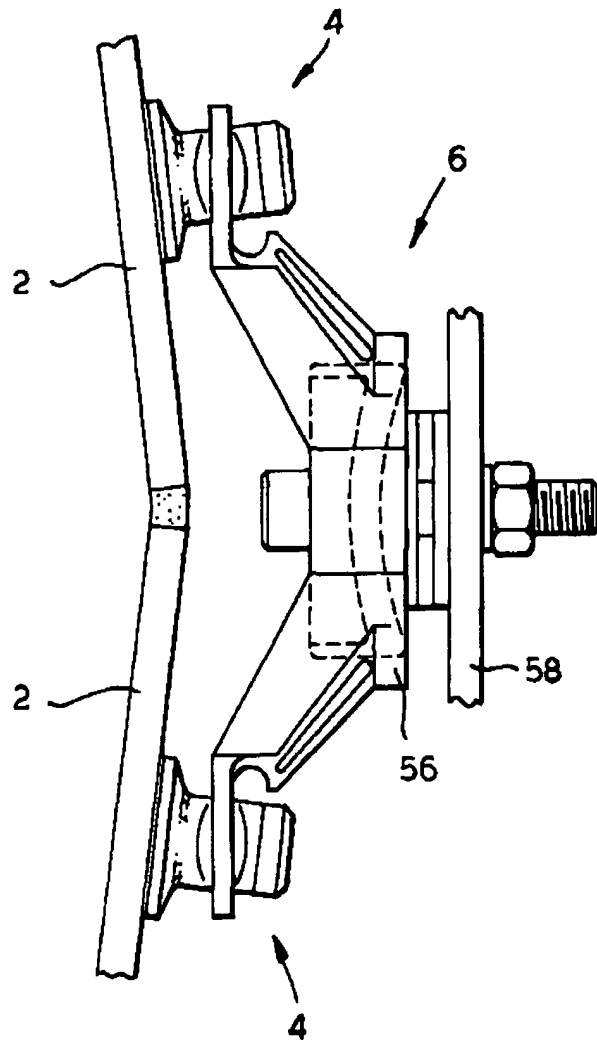




Fig.5.





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# EUROPEAN SEARCH REPORT

Application Number  
EP 97 30 0174

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claims	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X Y	EP 0 617 190 A (VERTAL SUD-EST) * column 4, line 50 - column 6, line 2 * * column 6, line 18 - line 48 * * figures *	1,6,10 2-5	E04B2/88 E06B3/54 E04F13/08
Y	EP 0 064 290 A (HILTI) * page 11, paragraph 1 - paragraph 4; figure 3 *	2-5	
A	FR 2 262 722 A (EBBING) * page 7, line 16 - page 8, line 5; figures 3-5 *	1-5	
A	GB 2 178 471 A (PILKINGTON BROTHERS) * page 2, line 89 - line 99 * * page 3, line 78 - page 4, line 13 * * figures 3,7,8 *	7-9	
A	EP 0 374 970 A (AMANCO L + F AG) -----		
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			E06B
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		21 April 1997	Depoorter, F
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